(12) UK Patent Application (19) GB (11) 2 212 406 (13) A

(43) Date of A publication 26.07.1989

(21) Application No 8829886.4

(22) Date of filing 22.12.1988

(30) Priority data
(31) 8718147 (32) 24.12.1987 (33) FR

(51) INT CL⁴
A63B 53/04

(52) UK CL (Edition J)
A6D D23B
B5A AT3P A1R214A A1R214B A1R214F A1R314C3
A1R314C5 A1R428
U1S S1161

(56) Documents cited
US 3571900 A2

(58) Field of search
UK CL (Edition J) A6D D23B, B5A AT3P
INT CL⁴ A63B

(71) Applicant
Patentex S A

(Incorporated in Switzerland)

1 Grand'Places, Fribourg, Switzerland

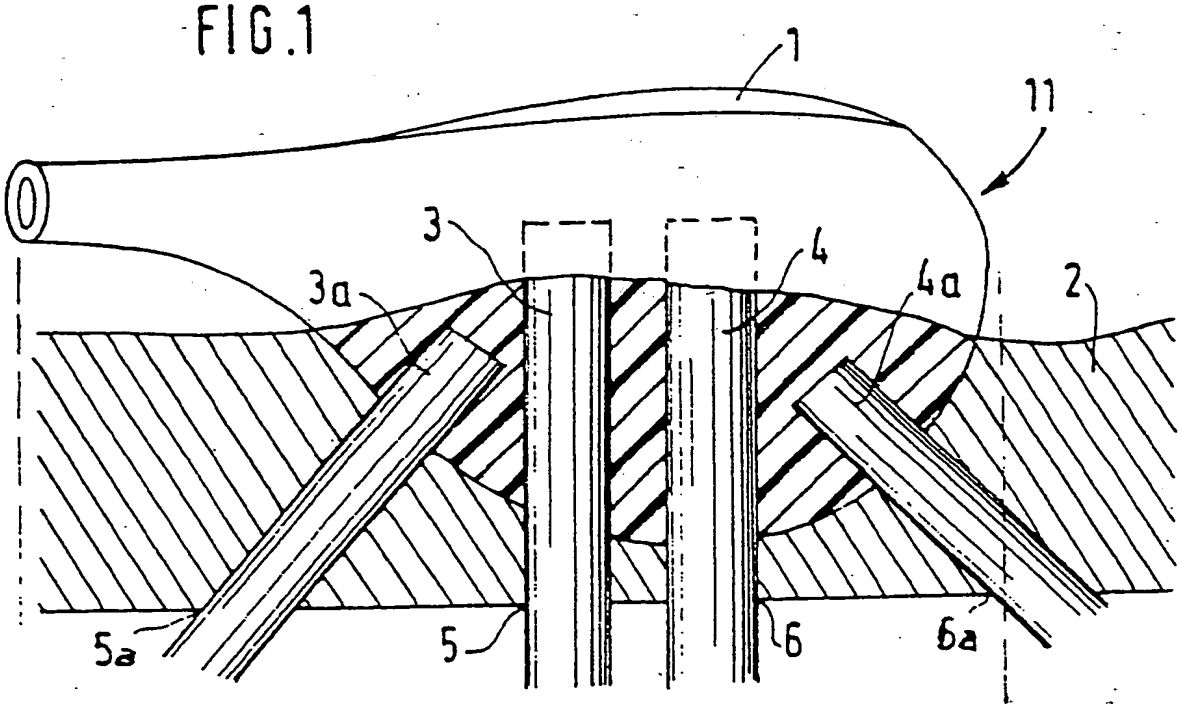
(72) Inventors
Rene Lacoste
Catherine Lacoste De Prado

(74) Agent and/or Address for Service
Mewburn Ellis
2 Cursitor Street, London, EC4A 1BQ, United Kingdom

(54) Golf club head

(57) A golf club head is moulded in a mould in a single operation to give it a predetermined shape and volume. However, the weight of the head is predetermined during moulding by the introduction into the mould of movable parts (3, 3a, 4, 4a) which are withdrawn from the mould and from the head before removal of the latter from the mould and which create cavities of a greater or lesser depth. Thus heads may be made in the same mould, of the same material, but of different weight characteristics. The hole(s) may be plugged and/or wholly or partly filled with inserts. The heads may be formed of polyurethane and the cavities may be filled with expanded foam sealed in with epoxy resin. Reinforcing fibre may be used in the head portion.

FIG.1



GB 2 212 406 A

FIG.1

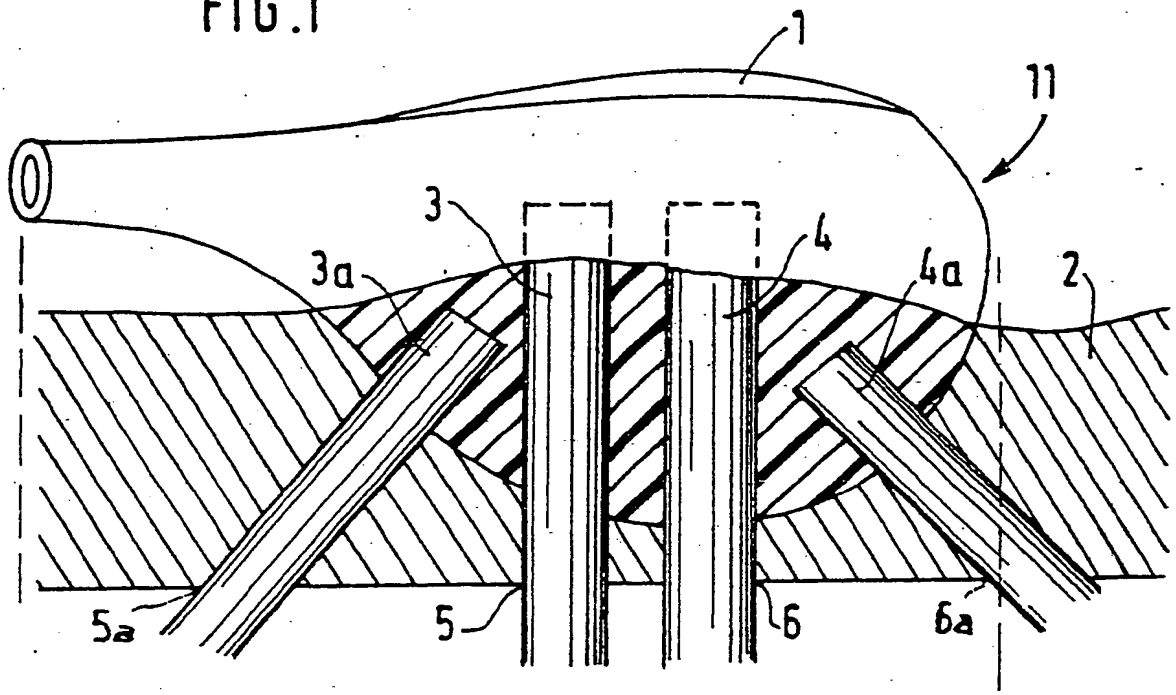


FIG.2

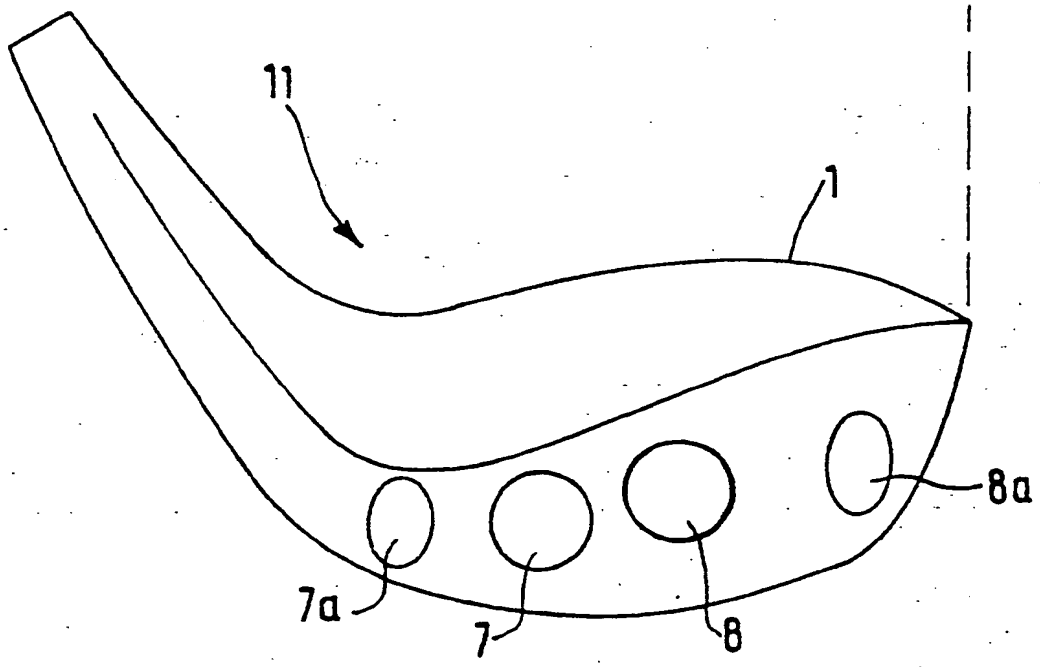


FIG.3

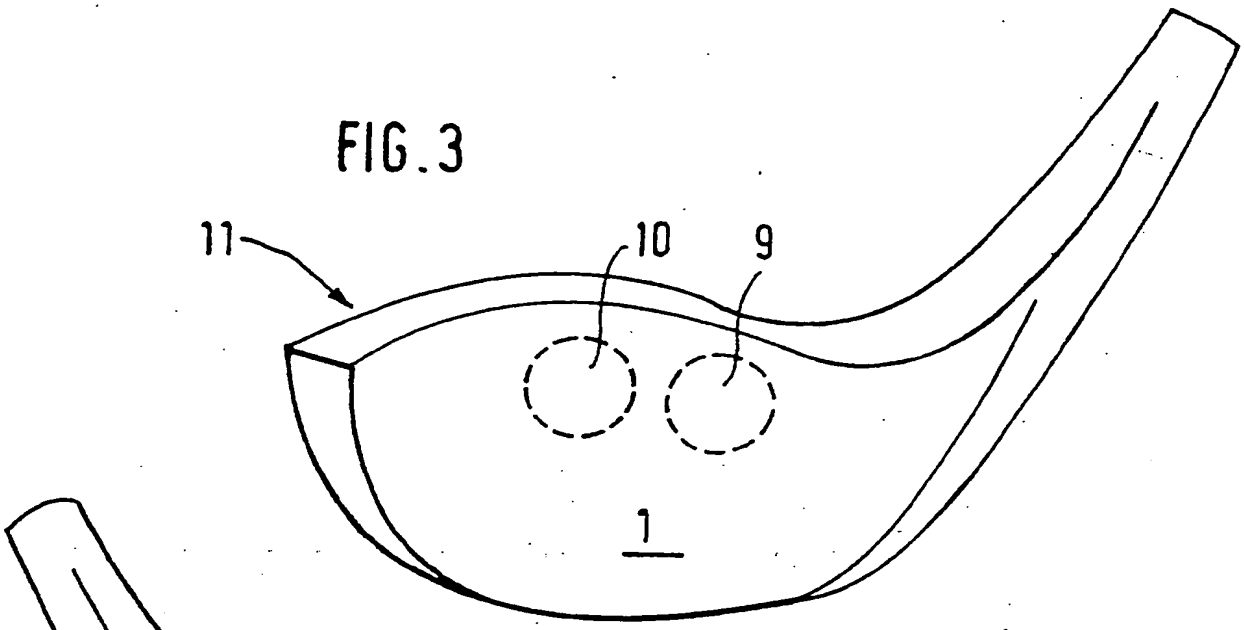


FIG.4

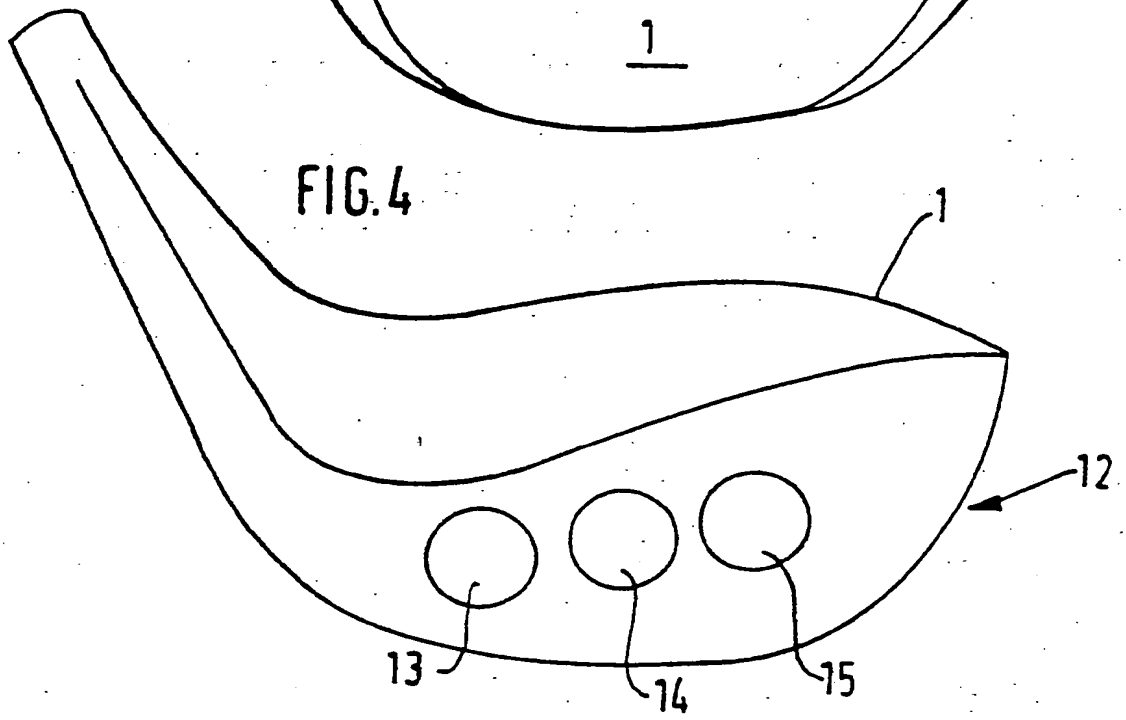


FIG.5

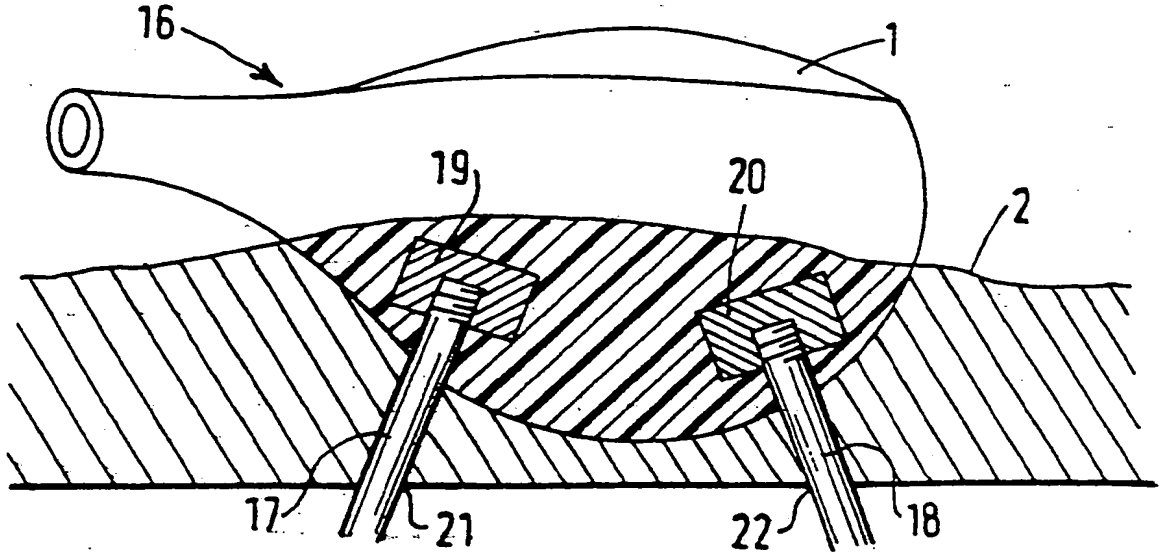


FIG.6

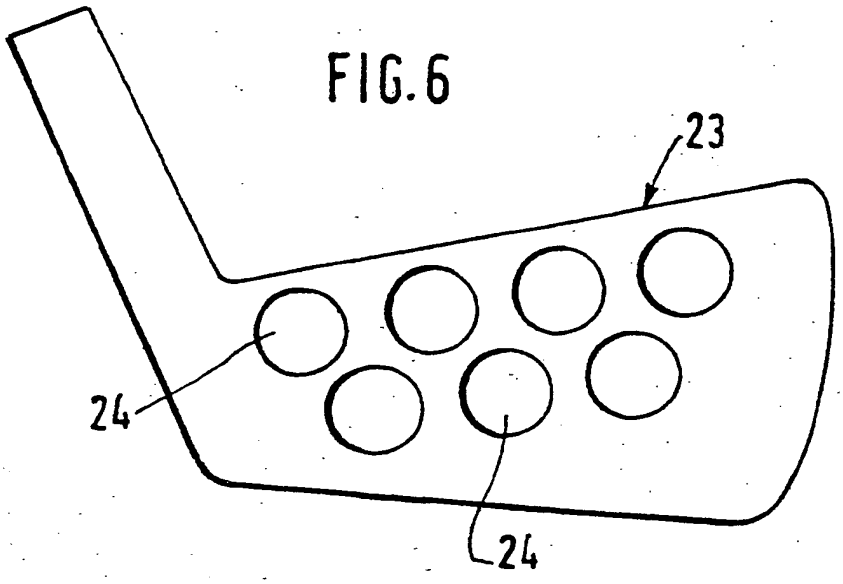
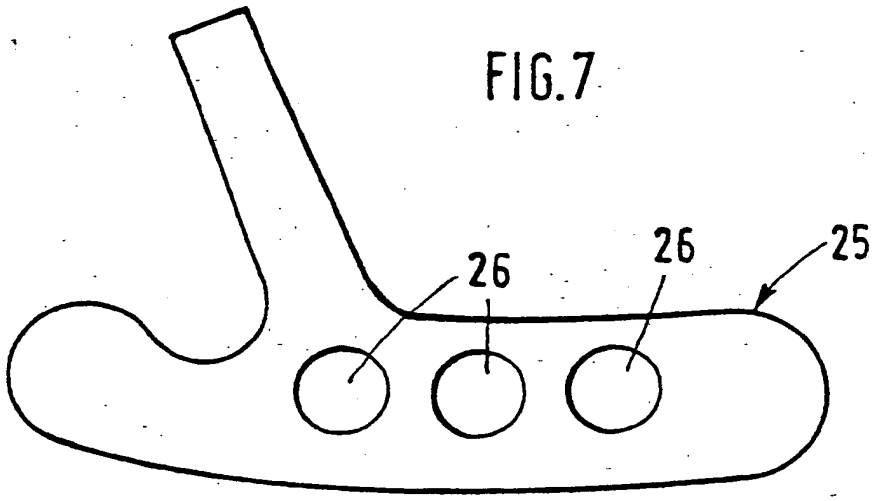


FIG.7



2212406

GOLF CLUB HEADS

This invention relates to the heads of golf clubs, to golf clubs incorporating such heads and to methods of making those heads.

Golf players use three types of clubs

- the "woods" with heads which are even now often made of wood, whence their name. The "driver" or "No. 1" has the longest handle allowing for the maximum amount of speed to be given to a ball placed on a the "tee". The other woods are numbered from 2 to 7 as a function of the shorter length of their handles and of the progressively greater slope of the faces of their heads, these heads being smaller than those of No. 1's;
- the "irons" with even shorter handles and heads made of metal;
- the "putter" just for rolling the ball to the hole in the greens.

Previously, the heads of the woods were made by being machined out of wooden blocks, usually of persimmon wood, or were made up of layers of wood and resin, and protected from contact with the soil by metallic plates. The heads of irons and of putters were made up of metallic parts, usually forged.

But nowadays, many irons and putters have moulded

heads and many woods have heads that are either moulded in metal or in plastic materials reinforced by fibres, usually graphite.

On the other hand, with the lighter handles now available, especially those made up of polymers reinforced with various fibres such as graphite or boron, it is possible to obtain sufficient strength with lighter and lighter clubs, provided that the heads are correspondingly lighter.

At the same time, in order to allow beginners and moderate players, who do not always strike the ball in the centre of the face of the club, to obtain the best possible results with these light handles and heads, it is desirable, particularly in the case of the woods, to increase the area of the club face in which ball contact allows a good transfer of energy with the least possible vibration and feeling of jolting.

Manufacturers have therefore been led to increasing the club's rotational moment of inertia about its longitudinal equilibrium axis.

For these reasons above all - the quest for lightness and an increase in the moment of inertia - heads have been made up of metal with a substantial central void within quite a thin wall. Heads in reinforced plastic material, obtained for example by moulding two parts and assembling them by screwing and gluing may also have voids. With these heads and also with the heads made from layers of

wood and of resin, the load provided by the plates protecting them from contact with the ground and is sometimes increased, with substantial manual intervention, by lead or copper parts or by screws placed either at the "point" of the head, or at the back of the head, or even by little containers filled to a greater or lesser extemt by lead powder.

But it has to be admitted that many golf players, particularly many of the better ones, still prefer to use as their "No. 1's" heads frequently of substantial volume without a void and only slightly loaded - for example just by a single screw in the middle of their lower faces.

Here it should be noted that it is usual and sensible for the woods other than "No. 1's", to have smaller but heavier heads than the "No. 1's", so as to be able to get with shorter handles the same swing weight as for "No. 1's". The expression "swing weight" describes a measurement made with special balances of the force required of the player to handle the club in carrying out the movement of striking the ball.

In these circumstances, these heads, smaller and heavier than "No. 1" heads have smaller voids and thicker walls.

But with the larger and lighter heads of the "No. 1" woods, most players complain of a lack of power when using metallic heads whose striking face is thin, and also when using hollow heads made of reinforced plastic materials.

It is interesting to note here that, in US Patent no. 3 390 881 describing a head made up of a wooden core and an insert together covered by a layer of polyurethane moulded about the core, it is said that:

"Solid clubs moulded from synthetic resins have been produced commercially, but by preferred standards of golf club performance they have not been satisfactory. Examples of these plastics are nylon, acrylonitrile-butadiene-styrene copolymers and polycarbonates. Because of the density of these plastics is greater (by over 100%) than that of wood, it has been necessary to incorporate a central cavity in the solid plastic head. Major disadvantages of this construction are that they do not produce the desired sound on impact, and its dynamic characteristics, particularly in terms of distance, are not so good as those of a conventional wood club".

However, according to US Patent No. 4 326 716, using polyurethane mixtures allowing the achievement not only of a greater hardness than that of wood, but also of exceptional resilience and abrasion resistance, it has been possible to obtain, without any metallic protective plate and with very little manual intervention heads for "Nos. 3, 5, 7 woods", for example, which give better results even than those possible by any other means. Also heads for "No. 1 woods" entirely made by moulding in a single operation and without a central cavity, gave results equal or superior to those obtained with persimmon heads.

However these "No. 1 woods" heads have a volume of the order of 165 cm^3 giving, without loading, a weight of only 205 g for the lightest or longest clubs.

The present invention concerns heads for "woods", according to the above mentioned US patent No. 4326716, but in addition those moulded of other materials and also the heads of "irons" and "putters".

According to a first aspect of the present invention there is provided a golf club head, moulded in a single operation, with regions of different densities formed during moulding by pieces independent of the mould, and which are withdrawn before removal of the mould.

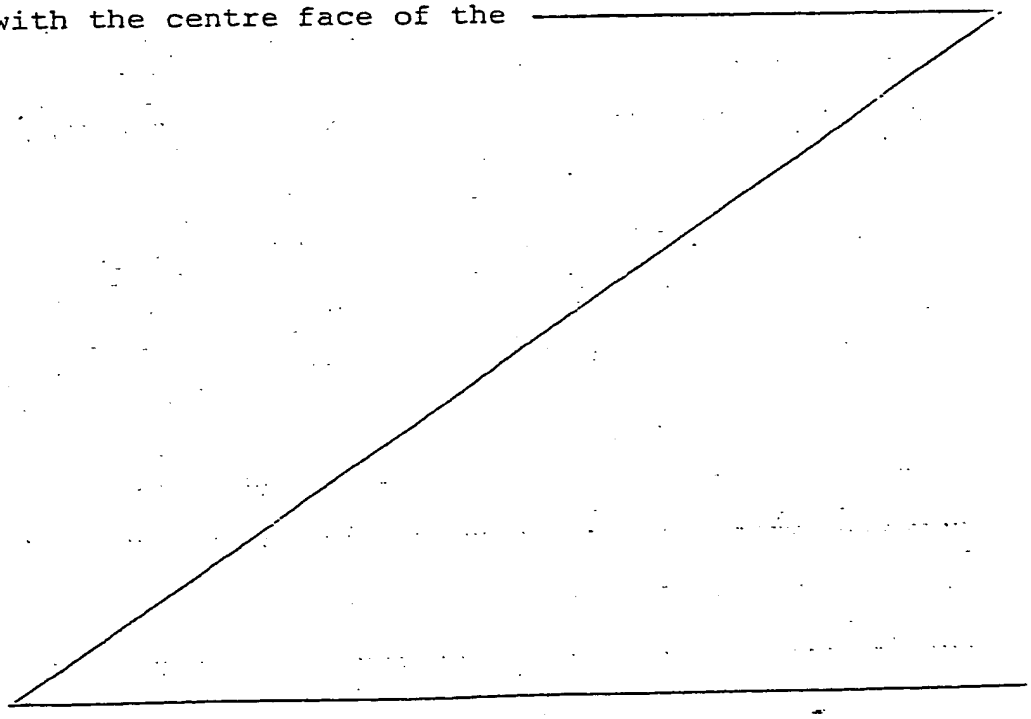
According to a second aspect of the present invention, the moulded head of a golf club is characterised in that its mass may be predetermined thanks to the insertion into the mould before moulding of movable parts able to be withdrawn from the mould and from the head after moulding.

In a third aspect, the present invention provides a method of making a head for a golf club by moulding in which at least one projecting element in the mould forms corresponding cavities in the head, and is removed from the mould before the head is removed from the mould.

An object is to allow an increase in the volume of the heads of "No. 1" woods and in their moment of inertia by processes embodying, by means of and during the moulding, lightenings not having the disadvantages of the usual central voids.

A further object is to allow an increase in the mass of the smaller heads of other woods.

Yet a further object is to achieve, for the heads of all types of clubs - and with the minimum amount of costly manual intervention - the optimum distribution of mass so as to increase that surface of the striking area which is effective and pleasurable for the least skillful players without cutting down the results expected by better players who regularly hit the ball with the centre face of the



clubs.

Other characteristics and advantages of the invention will appear in the course of the description which is about to follow of particular modes of embodiment, given solely by way of non-limitative example, referring to the drawings.

Brief Description of the Drawings

- Figure 1 is a diagrammatic view during moulding of a "No. 1" wood head with a volume of 175 cm^3;
- Figure 2 is a view of the rear portion of this completed head;
- Figure 3 is a view of the face of this head;
- Figure 4 is a view of the rear portion of a "No. 1" wood head with a volume of 180 cm^3;
- Figure 5 is a diagrammatic view of a "No. 3" wood head with a volume of 140 cm^3;
- Figure 6 is a view of the rear portion of a "No. 6" iron; and
- Figure 7 is a view of the back portion of a "putter".

In Figure 1, it can be seen that two holes 5 and 6 have been pierced in the wall of mould 2 to introduce into the latter two cylinders 3 and 4 the axes of which are arranged in such a fashion as to be placed in a plane approximately perpendicular to the surface of the part of the mould forming the ball-striking face 1 of the head of the club. After the moulding operation, these two cylinders are withdrawn and the moulded head 11 will have

on its rear portion two cylindrical cavities of the same diameter as that of cylinders 3 and 4 not opening into face 1 of the head.

With a volume of 175 cm^3 for a "No. 1" wood head and a density of for example 1.226 for a mixture of polyurethane, for example as described in U.S. Patent no. 4 326 716, one would have, without any lightening, a weight of 175 X 1.226 = 214.55 g, which is too much weight to allow of a swing weight acceptable for use with handles of the types and lengths used today by the best players, and also by the tallest ones.

On the other hand, by having cylindrical cores 1.4 cm in diameter penetrate 4 cm into the mould, (thereby keeping more than a centimeter of thickness between the base of the cavities made upon the withdrawal of the cylinders and the wall of the face 1 of the head) there is obtained a lightening of:-

$$\frac{1.4}{2} \times \frac{1.4}{2} \times 3.1416 \times 4 \times 1.226 \times 2 = 15.098 \text{ g}$$

allowing the head to have a weight of less than 205 g, even if one fills the cavities with very light expanded foam and blocks them with deposits of epoxy resin or little glued or screw threaded plugs. Placed at the rear of the head, these plugs do not undergo any shock and are moreover pushed towards the front and therefore held in place when the ball is struck.

Of course, in order to obtain weights of between 214.55 g and 205 g, all that is necessary is to lessen the

length of the portion of the cylinders that is introduced into the mould.

The depth of the cavities can instead be kept the same and the length and density of the plugs increased, so as to get weights greater than 214.55 g. These plugs can possibly be joined together in a single piece making up one portion of the rear of the head.

Still with the aim of obtaining a central region of low density and at the same time regions of higher density at the front and at the edge of the head, it is possible to arrange for cavities such as those made by the cylinders 3a and 4a shown in Figure 1. In this case, the heads will still have deep central cavities closed by light plugs. The variations and increases in weights for the heads required to fit out certain clubs, are therefore obtained by filling the cavities made by cylinders 3a and 4a with glued or screwed in bits of greater or lesser density, for example in nylon, aluminium or copper and/or with a greater or lesser degree of hollowness according to the weight being aimed at.

In Figure 2, can be seen sites 7 and 8, and possibly 7a and 8a of the plugs blocking up the cavities.

In Figure 3, the position of the dotted circles 9 and 10 representing the holes which would be made on the face of the heads if the portion of the cylinders introduced into the mould were to be extended to the maximum demonstrates how the lightening of the heads is obtained.

as desired, especially in the central and upper part of the head.

In Figure 4, showing a head 12 of a "No. 1" wood with a volume of 180 cm^3, we have, without any lightening, a weight of 220.68 g. Under the same conditions as for the 175 cm^3 head, but with three cylinders forming the cavities 13, 14, 15 instead of two, of the same diameter of 1.4 cm, one gets, as is seen in Figure 4, a lightening of 22.64 g permitting a weight of less than 205 g to be achieved.

However, the same measures as in the first example would permit heavier heads to be obtained.

In figure 5, head 16 of 140 cm^3 of a "No. 3" wood, moulded without loading or lightening with the same mixture of polyurethane as that of the heads of "No. 1" wood above, only weighs 171.64 g, which is much less than the weight of about 210 g, needed for a "No. 3". As before, in order to weight this head, cylinders 17 and 18, for example 0.4 cm in diameter are introduced through holes 21 and 22 in the wall of the mould 2.

Then inserts 19 and 20 for example of copper are gently screwed onto the ends of the cylinders, before closing the mould.

After moulding, the cylinder cores 17, 18, are unscrewed from the inserts 19, 20 and the cylinders are withdrawn. There is achieved for the head including the inserts, an increase in weight relative to the weight of 171.64 g of which will be the difference between the weight

of the inserts and the combined weight of the volume of polymer replaced by the inserts and the volume of polymer displaced by the withdrawn cylinders.

Assuming that the cylinders are 2 cm long (within the mould) and that a total weight of 210 g is required for the head of "No. 3" wood 16, which is the normal weight for getting with a shorter handle the same swing weight as for a "No. 1" wood with a 205 g head, it is possible to find the weight P of each insert by using the following formula:

$$210 - 171.64 = P - P \times \underbrace{\frac{1.226}{8.9}}_{\substack{\text{(polymer density)} \\ \text{(copper density)}}} + \frac{0.4}{2} \times \frac{0.4}{2} \times 3.1416 \times 2 \times 1.22$$

which gives: P = 22.60 g.

The weight of the head can of course be lessened or increased by lessening or increasing the volume of masses 19 and 20 and increased for example by filling with copper screws the cavities left by the withdrawal of cylinders 17 and 18.

In both the above examples of "No. 1" wood heads, just as good results could of course have been achieved with more cylinders (and cavities) with smaller diameters.

With a head of greater volume than, for example, 180 cm^3 the necessary lightening should and could of course be obtained by increasing the number and/or the diameter of the cylinders (and the cavities).

In the example of "No. 3" wood head, the two pieces 19 and 20 can be joined into a single extended piece, lighter

in the middle than at the ends and held in the mould by a single little cylinder.

Alternatively it is possible as far as head 16 is concerned to replace the cylinders 17 and 18 of 0.4 cm in diameter, by bigger cylinders say 1.2 cm in diameter and to simply fill the cavities made with lead cylinders.

It is possible to determine weight P of each lead cylinder from the following formula:

$$210 - 171.64 = P - P \times \frac{1.226}{10.3} \quad \begin{matrix}\text{(polymer density)} \\ \text{(lead density)}\end{matrix}$$

which gives the result:

$$P = 21.78 \text{ g.}$$

Each cavity-making cylinder should penetrate into the mould and make in the head a cavity of the length of

$$L = \frac{21.78}{0.6 \times 0.6 \times 3.1416 \times 10.3} = \frac{21.78}{11.64} = 1.87\text{cm}$$

On the other hand, it should be noted that, just like the plugs 7 and 8 of the "No. 1" wood head 11 the lead cylinders will be strongly driven towards the base of the holes by the impact and direction of striking the ball.

Similar results can be obtained in the same way in order to adjust the weights of heads of "Nos 2, 4, 5, 6 or 7" woods and also when heads are moulded from other polymers whether reinforced by any type of fibre, or not reinforced, the lightening being carried out in the middle portion of the head and any loading being spaced from that middle part.

The lightenings carried out leave, between the cavities and, behind the ball-striking face of the head, a solid mass which can be considered as a partition more or less perpendicular to the face to maintain its rigidity, and to give practically the same restoration of energy as a head without voids. It also gives a much flatter and more agreeable sound than that of heads having a substantial central cavity without divisions.

The arrangement of loads outside the central part and/or close to the outside surface of the head, increases its moment of inertia and increases the area of that region of the face over which the ball may be stuck efficiently and agreeably with the minimum feeling of shock and vibration.

Lastly, the variability in predetermined weight is essentially obtained by moulding with the same mould and without many subsequent costly manual operations, which would not give the same guarantees of durability as the solutions characteristic of the invention.

In Figures 6 and 7, there are heads 23 of an iron and 25 of a putter 22 both made by moulding. We see rows of cavities 24 lightening the rear upper central part of these heads in such a way as to increase their moment of inertia and the efficient and agreeable striking area, at the same time maintaining by the divisions between the cavities 24 and 26 respectively, with a good restoration of energy for the central portion of the faces thereby obtaining a more

agreeable sound and less vibrations than by making a wider area thinner.

In order to obtain a similar result with a thinner head of less external volume, it is also possible, especially with putters, to only make the cavities outside the central part or over all the rear surface of the head, and to then place, in the cavities spaced away from the central part, high density pieces.

From the process point of view, it is possible to obtain, with the same mould, heads of different weights for the same type of iron or of putter, without any manual intervention after moulding, by introducing more or less deeply the cavity - forming pieces into the mould, exactly as for a "No. 1" wood as explained previously.

In practice, the cylinders can be fast with each other and penetrate together into the holes in the mould, and for "irons", it is possible to block all the cavities with a filling of epoxy resin or a little plate of plastic material giving to the back of the club a uniform surface-useful from the aerodynamic point of view.

In general, for all types of head, it is possible to provide, on one part of the length of the cylinders, a screw thread. In this case, the withdrawal of the cylinders has to be made by rotation and leaves a screw-threaded cavity in the head, allowing the screwing in of plugs or heads.

Of course many variations may be introduced especially

by substitution of technically equivalent means without thereby exceeding the limits of the invention, especially by using other polymers.

Throughout the specification density is expressed as a relative density.

CLAIMS:

1. A golf club head, moulded in a single operation in a mould to give it a predetermined volume and shape, wherein its weight is variable and is fixed by and during moulding by the creation of areas of different densities in the said head, due to the introduction before moulding, to a predetermined depth into the mould, through holes pierced in the part of the mould wall forming the rear part of the head, of one or more pieces independent of the mould, withdrawn from the mould and from the head before removal from the mould, making cavities of the predetermined depth in the head.

2. A golf club head according to claim 1, wherein the piece or pieces introduced into the mould, are cylinders sliding into holes in the mould pierced in such a way that the cavities made by the withdrawal of the cylinders are in the central part of the head and their axes are in planes substantially perpendicular to the striking face.

3. A golf club head according to claim 1 or claim 2, including at least two cavities the bases of which are close to the upper part of the striking face, the moulded material between the cavities making a partition perpendicular to the striking face and to the upper face of the head, in such a way as to reinforce them and stiffen the striking face.

4. A golf club head, according to claim 1, in either reinforced or unreinforced polymer material, in which inserts are provided which are mounted on said pieces and which remain in the cavities after removal of the pieces.

5. A golf club head in reinforced or non-reinforced polymer material according to any one of claims 1 to 3, wherein the cavities or portions of cavity placed near the face and in the middle part of the head are filled with materials or pieces the density of which is lower than that of the moulded polymer.

6. A golf club head according to any one of claims 1 to 4, wherein the cavities or parts of cavity placed on the back part of the head and/or outside the central part are more or less filled by pieces or materials the density of which is greater than 7.

7. A golf club head according to any one of the preceding claims, wherein the piece or pieces forming the cavities are cylinders of which at least some have a screw-thread on one portion of their lengths.

8. A head for a golf club which is a moulded body having a front face for striking a golf ball and a rear face opposite said front face, at least one moulded cavity formed in said rear face and extending to a predetermined distance generally towards the front face whereby the mass of the head is affected by the volume of said at least one cavity.

9. A head for a golf club substantially as herein described with reference to the accompanying drawings.

10. A method of making a head for a golf club comprising using a mould defined by a wall to be of predetermined shape and volume;

introducing at least one element to the mould through the wall to project to a predetermined extent into the mould;

casting a hardenable material into the mould and around said projecting element to adopt said predetermined shape;

hardening the material;

withdrawing said or at least one projecting element from the hardened material to leave at least one cavity in said shape; and

removing the hardened material from the mould.

11. A method according to claim 10 wherein at least one of said elements comprises a detachable portion and said method comprises casting said material around at least said detachable position of said element, hardening the material, detaching the element from its detachable portion and withdrawing the element, leaving the detachable portion in the material.

12. A method according to claim 10 or claim 11 which includes at least partially filling at least one of said cavities with an insert of predetermined density and mass in relation to the material.

13. A method according to any one of claims 10 to 12 wherein there are two said elements and these are non-parallel.

14. A method of making a head for a golf club substantially as herein described with reference to the accompanying drawings.

Published 1989 at The Patent Office, State House, 66-71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office.